Bias Comparisons for LSEM, Path, and CISE-alpha Models

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Path

eX —0→ [X] ══════════════⟹ [Y] ←0— eY
0   0

CISE

eX ——→ [X] ←1— (ξ) ═══════════⟹ (η) —1→ [Y] ←—— eY

eX =((1-
alpha)*variance)

eY =((1-
alpha)*variance)

LSEM

Latent Structural Equation Model

Monte Carlo Simulation
N = 500
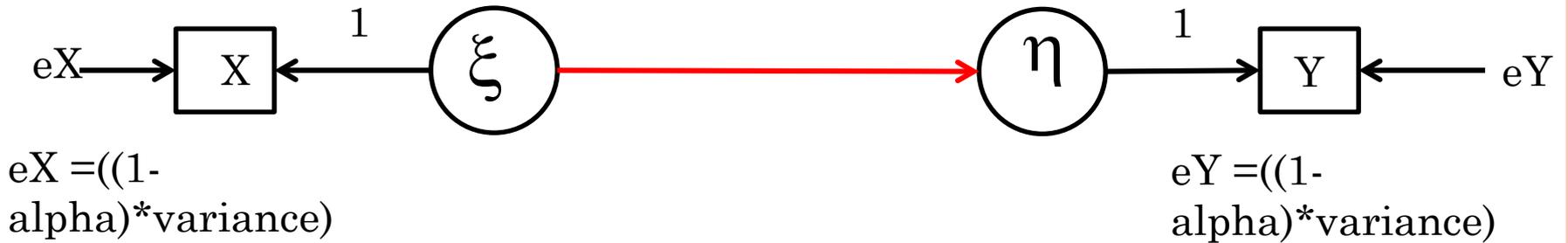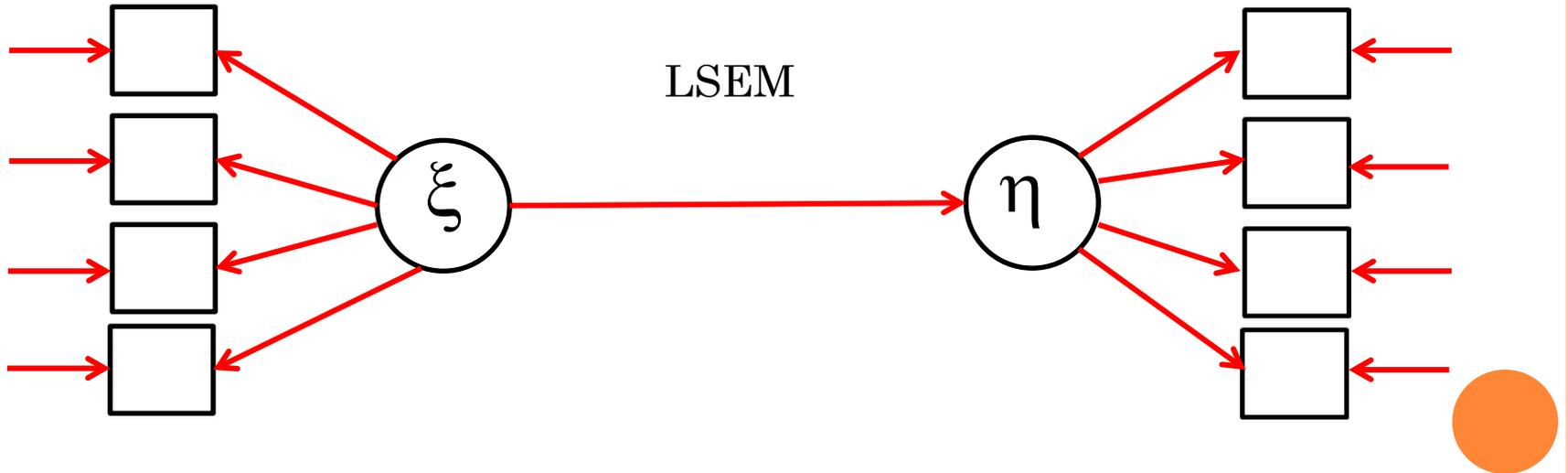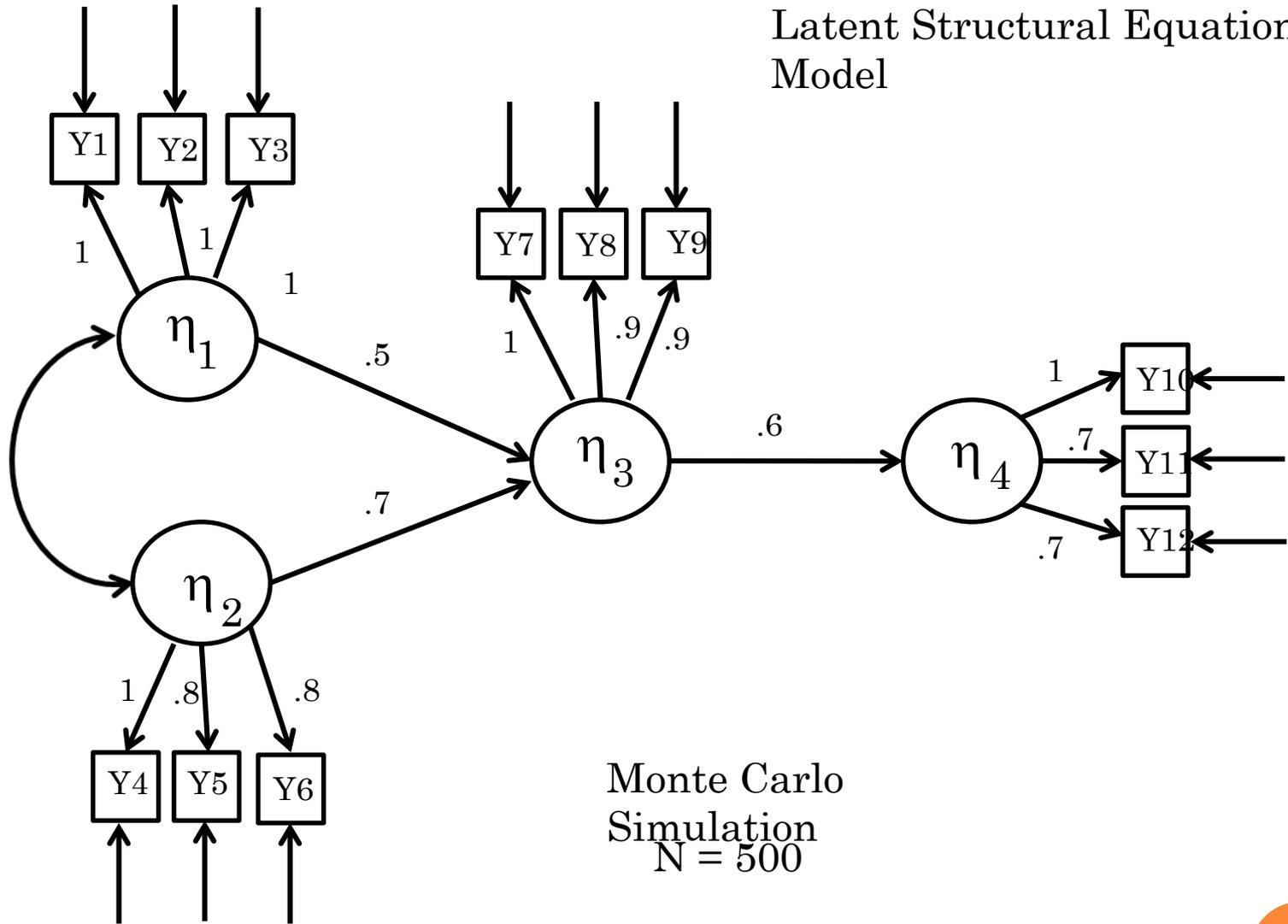
```
title:   this is an example of a SEM with
         continuous factor indicators

montecarlo:
         names = y1-y12;
         nobs = 500;
         nreps = 1;
         save = ex5.11.dat;

model montecarlo:

         f1 by y1@1 y2-y3*1;
         f2 by y4@1 y5-y6*.8;
         f3 by y7@1 y8-y9*.9;
         f4 by y10@1 y11-y12*.7;

         y1-y12*1;
         f1-f2*1;
         f3-f4*.5;

         f3 on f1*.5 f2*.7;
         f4 on f3*.6;

model:

         f1 by y1@1 y2-y3*1;
         f2 by y4@1 y5-y6*.8;
         f3 by y7@1 y8-y9*.9;
         f4 by y10@1 y11-y12*.7;

         y1-y12*1;
         f1-f2*1;
         f3-f4*.5;

         f3 on f1*.5 f2*.7;
         f4 on f3*.6;

output:
         tech9;
```

Latent Structural Equation Model
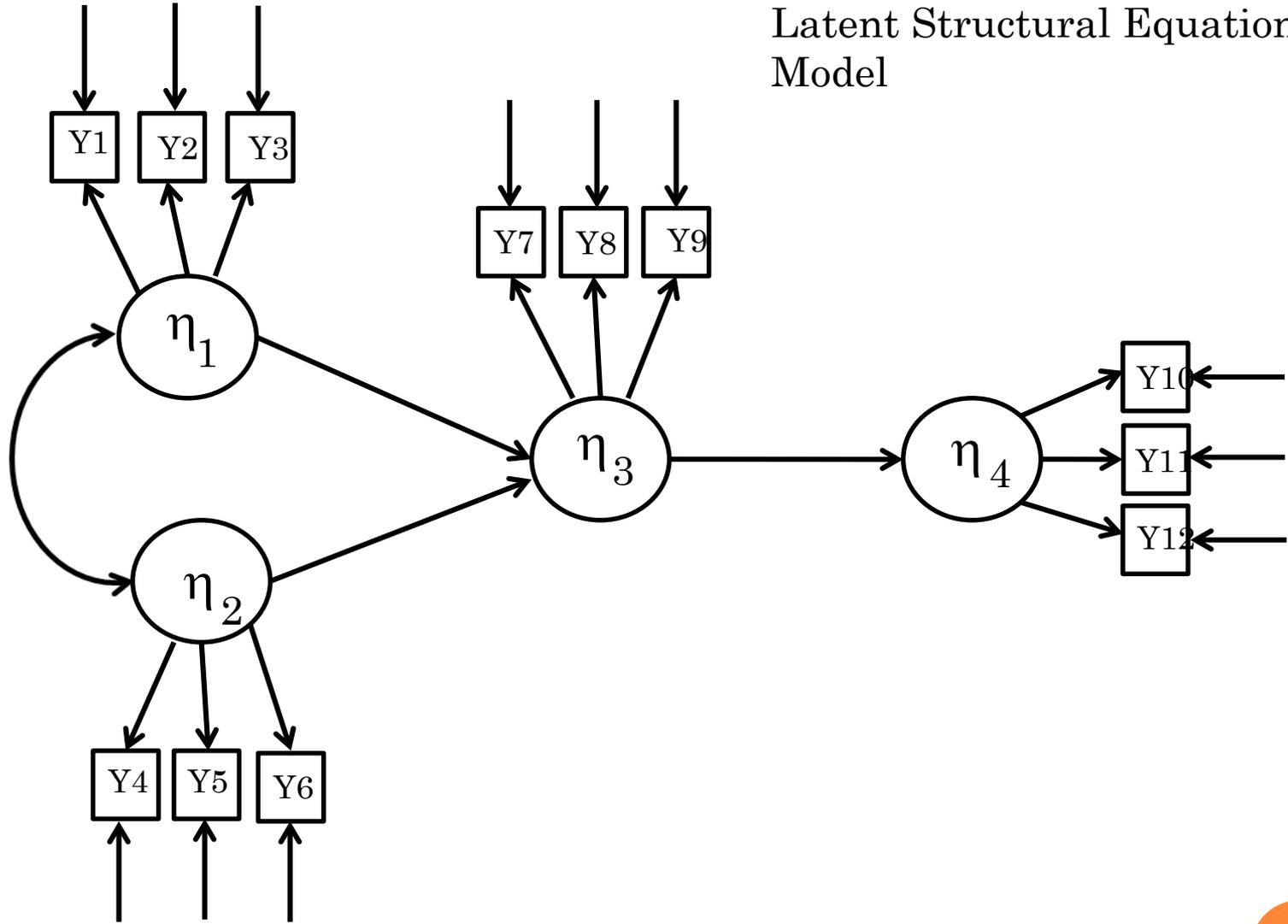
Latent Structural Equation Model

```
INPUT INSTRUCTIONS

 title: Monte Carlo Study CISE
 data: file is MC.dat;
 variable: names are y1-y12;
 model:
     factor1 by y1-y3;
     factor2 by y4-y6;
     factor3 by y7-y9;
     factor4 by y10-y12;
     factor4 on factor3;
     factor3 on factor1 factor2;
```

Latent Structural Equation Model

```
MODEL RESULTS

                                                     Two-Tailed
                        Estimate      S.E.   Est./S.E.   P-Value

FACTOR1  BY
    Y1                   1.000       0.000    999.000    999.000
    Y2                   1.183       0.104     11.376      0.000
    Y3                   0.938       0.087     10.818      0.000

FACTOR2  BY
    Y4                   1.000       0.000    999.000    999.000
    Y5                   0.870       0.085     10.202      0.000
    Y6                   0.891       0.092      9.735      0.000

FACTOR3  BY
    Y7                   1.000       0.000    999.000    999.000
    Y8                   0.872       0.059     14.699      0.000
    Y9                   0.882       0.060     14.611      0.000

FACTOR4  BY
    Y10                  1.000       0.000    999.000    999.000
    Y11                  0.826       0.094      8.812      0.000
    Y12                  0.682       0.089      7.696      0.000

FACTOR4  ON
    FACTOR3              0.473       0.057      8.306      0.000

FACTOR3  ON
    FACTOR1              0.563       0.070      8.027      0.000
    FACTOR2              0.790       0.086      9.228      0.000

FACTOR2  WITH
    FACTOR1             -0.030       0.055     -0.545      0.586
```

```
MODEL FIT INFORMATION

Number of Free Parameters                    40

Loglikelihood

        H0 Value                     -9646.960
        H1 Value                     -9620.108

Information Criteria

        Akaike (AIC)                 19373.920
        Bayesian (BIC)               19542.505
        Sample-Size Adjusted BIC     19415.542
          (n* = (n + 2) / 24)

Chi-Square Test of Model Fit

        Value                          53.704
        Degrees of Freedom                 50
        P-Value                        0.3344

RMSEA (Root Mean Square Error Of Approximation)

        Estimate                        0.012
        90 Percent C.I.                 0.000   0.032
        Probability RMSEA <= .05        1.000

CFI/TLI

        CFI                             0.997
        TLI                             0.997

Chi-Square Test of Model Fit for the Baseline Model

        Value                        1524.403
        Degrees of Freedom                 66
        P-Value                        0.0000

SRMR (Standardized Root Mean Square Residual)

        Value                           0.027
```

Path Analysis Model
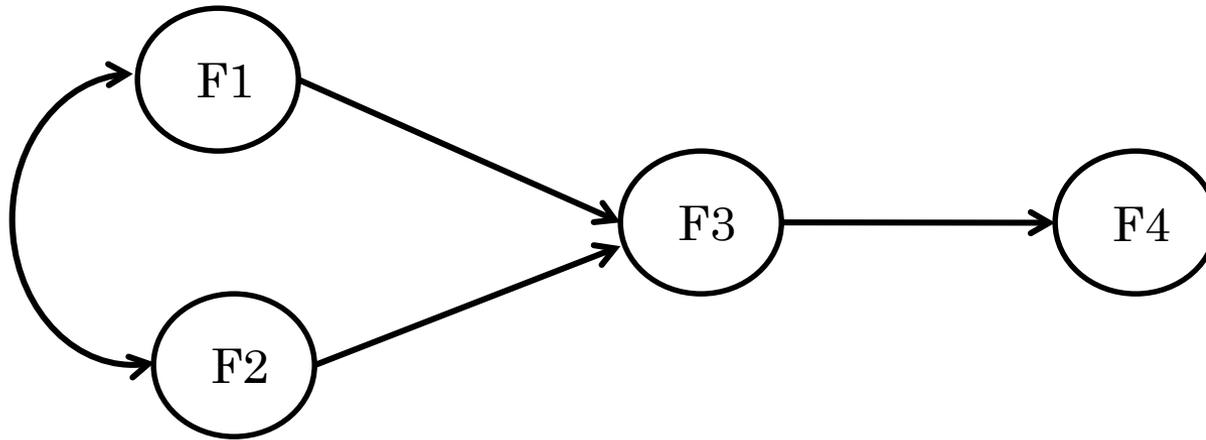
Path Analysis Model – zero error

```
INPUT INSTRUCTIONS

  title: Monte Carlo Study CISE
  data: file is cise.txt;
  variable: names are y1-y12 f1 f2 f3 f4;
  usevariable are f1 f2 f3 f4;
  model:
      f4 on f3;
      f3 on f1 f2;
      f1 with f2;
```

Path Analysis Model – zero error

```
MODEL RESULTS

                                                         Two-Tailed
                         Estimate       S.E.   Est./S.E.   P-Value

F4        ON
    F3                      0.346      0.033      10.581     0.000

F3        ON
    F1                      0.363      0.039       9.331     0.000
    F2                      0.545      0.042      12.994     0.000

F1        WITH
    F2                     -0.033      0.053      -0.613     0.540
```

```
MODEL FIT INFORMATION

Number of Free Parameters                         12

Loglikelihood

        H0 Value                        -2853.672
        H1 Value                        -2852.038

Information Criteria

        Akaike (AIC)                     5731.344
        Bayesian (BIC)                   5781.919
        Sample-Size Adjusted BIC         5743.830
          (n* = (n + 2) / 24)

Chi-Square Test of Model Fit

        Value                              3.267
        Degrees of Freedom                     2
        P-Value                           0.1952

RMSEA (Root Mean Square Error Of Approximation)

        Estimate                           0.036
        90 Percent C.I.                    0.000    0.103
        Probability RMSEA <= .05           0.536

CFI/TLI

        CFI                                0.996
        TLI                                0.989

Chi-Square Test of Model Fit for the Baseline Model

        Value                            306.652
        Degrees of Freedom                     5
        P-Value                           0.0000

SRMR (Standardized Root Mean Square Residual)

        Value                              0.018
```

CISE-alpha
Model
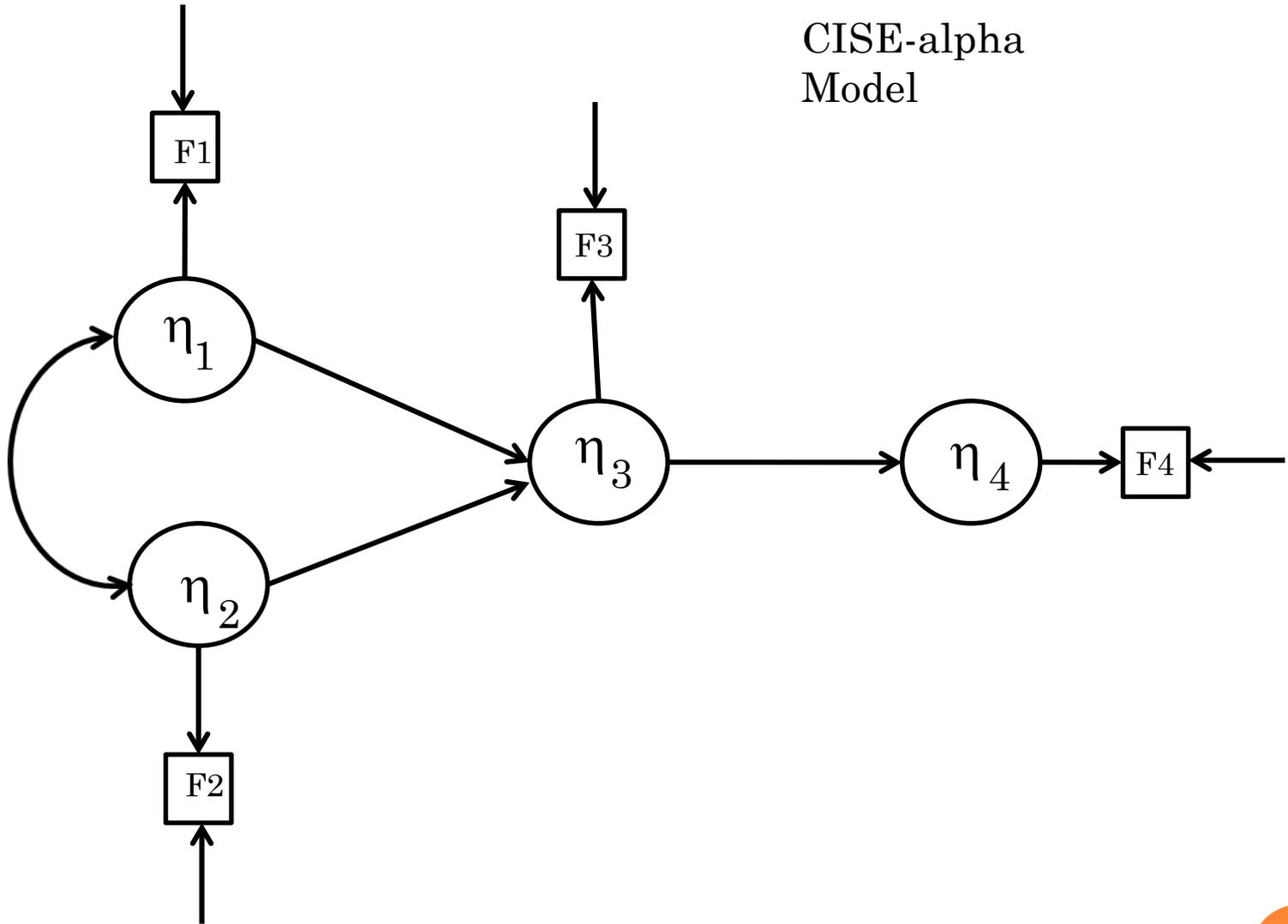
CISE – Alpha Model

```
INPUT INSTRUCTIONS

 title: Monte Carlo Study CISE
 data: file is cise.txt;
 variable: names are y1-y12 f1 f2 f3 f4;
 usevariable are f1 f2 f3 f4;
 model:
     factor1 by f1@1;
       f1@0.332;
     factor2 by f2@1;
       f2@0.352;
     factor3 by f3@1;
       f3@0.311;
     factor4 by f4@1;
       f4@0.363;
    factor4 on factor3;
     factor3 on factor1 factor2;
```

CISE – Alpha Model

```
MODEL RESULTS

                                                    Two-Tailed
                       Estimate      S.E.   Est./S.E.   P-Value

 FACTOR1   BY
    F1                   1.000      0.000    999.000    999.000

 FACTOR2   BY
    F2                   1.000      0.000    999.000    999.000

 FACTOR3   BY
    F3                   1.000      0.000    999.000    999.000

 FACTOR4   BY
    F4                   1.000      0.000    999.000    999.000

 FACTOR4   ON
    FACTOR3             0.433      0.041     10.447      0.000

 FACTOR3   ON
    FACTOR1             0.504      0.055      9.112      0.000
    FACTOR2             0.795      0.067     11.908      0.000

 FACTOR2   WITH
    FACTOR1            -0.033      0.053     -0.613      0.540
```

```
MODEL FIT INFORMATION

Number of Free Parameters                           12

Loglikelihood

        H0 Value                            -2853.329
        H1 Value                            -2852.038

Information Criteria

        Akaike (AIC)                         5730.659
        Bayesian (BIC)                       5781.234
        Sample-Size Adjusted BIC             5743.145
          (n* = (n + 2) / 24)

Chi-Square Test of Model Fit

        Value                                   2.582
        Degrees of Freedom                          2
        P-Value                                0.2750

RMSEA (Root Mean Square Error Of Approximation)

        Estimate                                0.024
        90 Percent C.I.                    0.000  0.095
        Probability RMSEA <= .05               0.624

CFI/TLI

        CFI                                     0.998
        TLI                                     0.994

Chi-Square Test of Model Fit for the Baseline Model

        Value                                 307.028
        Degrees of Freedom                          6
        P-Value                                0.0000

SRMR (Standardized Root Mean Square Residual)

        Value                                   0.015
```

	Population Value	LSEM	Path	CISE-alpha
ETA1 → ETA3	0.50	0.563	0.363	0.504
ETA2 → ETA3	0.70	0.790	0.545	0.795
ETA3 → ETA4	0.60	0.473	0.346	0.433
		Percent Parameter Bias	Percent Parameter Bias	Percent Parameter Bias
ETA1 → ETA3		+12.6%	-27.4%	+0.8%
ETA2 → ETA3		+12.8%	-22.1%	+13.5%
ETA3 → ETA4		-21.2%	-42.3%	-27.8%

LSEM	Path	CISE-alpha
$\chi 2$ = 53.704	$\chi 2$ = 3.267	$\chi 2$ = 2.582
degrees of freedom = 50	degrees of freedom = 2	degrees of freedom = 2
p = 0.3344	p = 0.1952	p = 0.2750
RMSEA = 0.012	RMSEA = 0.036	RMSEA = 0.024
SRMR = 0.027	SRMR = 0.018	SRMR = 0.015
$\chi 2$/degrees of freedom = 1.07	$\chi 2$/ degrees of freedom = 1.63	$\chi 2$/ degrees of freedom = 1.29
Free Parameters = 40	Free Parameters = 12	Free Parameters = 12